Kubilins
TRANSPORTATION GROUP, INC.

Sirrine-Haynie Neighborhood Master Plan

TRANSPORTATION SUPPLEMENT

PREPARED FOR:
The City of Greenville, SC

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NOTICE

The following report was prepared for The Lawrence Group and its designated agents, using information collected by Kubilins Transportation Group and/or provided by The Lawrence Group, the Greenville Department of Transportation, and the South Carolina Department of Transportation.

The methodology used to complete the evaluation is believed to be consistent with current traffic engineering practice. The recommendations presented herein are based on a preliminary review and analysis of the available data, direct observations, and the application of engineering judgment.

As stated within, this preliminary evaluation is intended as a supplement to the Sirrine-Haynie Neighborhood Master Plan, therefore review of the Master Plan is recommended and considered an integral component of this evaluation. A copy of the Master Plan can be obtained from the City of Greenville Economic Development Department.

Comments and questions about this study should be addressed to:

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INTRODUCTION

Kubilins Transportation Group, Inc. acting as a sub-consultant to *The Lawrence Group, Inc.* has evaluated travel patterns, capacity, and traffic distribution as an element of the Sirrine-Haynie Neighborhood Urban Design Project. This summary report reveals the findings regarding specific transportation issues. Recognizing the importance of Church Street to the urban fabric of the study area, the design team requested capacity analysis for the study corridor between Augusta Street and University Ridge. The intent of this evaluation is to determine if preliminary evidence exists to support a potential lane reduction from six to four travel lanes within the study area. It is important to note that this preliminary evaluation is not a substitute for a comprehensive traffic operations study of the subject corridor; however, it does provide evidence that such a study is warranted in order to fulfill the goals and objectives of the neighborhood master plan.

EXISTING CONDITIONS

Greenville is located in the Piedmont region of South Carolina in the foothills of the Blue Ridge Mountains. The area, commonly referred to as the *Upstate*, includes Greenville, Spartanburg, Anderson, Pickens and Cherokee counties and the cities of Anderson, Clemson, Greenville, Simpsonville, Greer and Spartanburg.

For the purpose of this project the study area included the section of Church Street between University Ridge and Augusta Street and is referred to a the "study area" throughout this report.

Church Street, a major arterial, currently exists as a six-lane section within the study area and includes three travel lanes in each direction varying in width between 11.5 and 12 feet, with a 4-foot monolithic concrete island in the center. This provides a total pavement width of 73 feet from lip of gutter to lip of gutter. A 1.5-foot curb and gutter is present along both sides of Church Street. In addition, sidewalks 4.5 feet in width line both sides of Church Street. The sidewalk is separated from the travel lanes by a 4-foot grass strip. The posted speed limit is 40 mph throughout the study corridor.

Study Corridor -Southbound Church Street

Augusta Street currently exists as a 4-lane section with two 11-foot travel lanes in each direction with a 10 foot left turn lane at the intersection of Church Street. A 4.5-foot wide sidewalk lines both sides of

Church Street as well as a 1.5-foot curb and gutter. The posted speed limit is 30 mph throughout Augusta Street. In addition, Church Street terminates to the south, in alignment with Mills Avenue. Mills Avenue exists as a tree lined 4-lane undivided roadway with ultimate connections to I-185.

University Ridge currently exists as a multi-lane facility west of Church Street and includes a dedicated left turn lane at the confluence of the two roadways. East of Church Street, University Ridge exists as a two-lane roadway with dedicated turn lanes at the intersection with Church Street. A 1.5-foot curb and gutter is present along both sides of University Ridge and the posted speed limit is 30 mph along the corridor.

COLLECTED DATA

In order to conduct a thorough evaluation of the travel patterns along the study corridor, the following data was collected as a part of this project:

Morning and afternoon peak hour turning movement counts were obtained from the City of Greenville at the following intersections:

- Church Street at Augusta/Mills Avenue (signalized)
- Church Street at University Ridge (signalized)

24-Hour Directional Counts, ADT's (Average Daily Traffic), were conducted along Church Street. The locations are listed below.

- Church Street north of University Ridge
- Church Street north of Augusta/Mills Avenue

A summary of all traffic count data has been included in the Technical Appendix of this report.

Inventories of existing conditions were also performed during the field investigation and site review. Collected data includes existing intersection configurations, lane widths, speed limits, and current traffic control measures (signing, marking, signals, etc.). General observations of intersection operations were made during this time.

Southbound Church Street at Augusta Street

TRAFFIC ANALYSIS

METHODOLOGY

The intersections identified within the area of influence were analyzed to identify the probable traffic impacts associated with the reconfiguration of Church Street. In order to determine the potential impact, the intersections were analyzed under existing and future-year 2011 conditions. These analyses are based on the Level of Service (LOS) at the identified intersections, and include a scenario that assumes a reconfiguration of Church Street within the study area.

Intersection capacity can be a complex concept. Simplified, the Transportation Research Board's ***Highway Capacity Manual***[1] (HCM) defines it as the flow rate of traffic through an intersection during a specified period. This flow rate is influenced by many factors, such as roadway geometry, signal configuration and timing, prevailing traffic conditions, and weather.

While capacity is a significant consideration and should not be overlooked, the evaluation of intersection operations is more appropriately based on Level of Service (LOS), which is a qualitative indicator of traffic operations. For signalized and unsignalized intersections, LOS is a measurement of delay time. The HCM defines six levels of service for intersections with LOS A representing the best operating condition and LOS F the worst. Table 9-1 of the HCM provides the criteria for signalized intersections, and Table 10-3 indicates the criteria for unsignalized intersections.

Table 9-1 SIGNALIZED

LEVEL OF SERVICE	STOPPED DELAY PER VEHICLE (SEC)
A	≤ 10.0
B	> 10.0 and ≤ 20.0
C	> 20.0 and ≤ 35.0
D	> 35.0 and ≤ 55.0
E	> 55.0 and ≤ 80.0
F	> 80.0

Table 10-3 UNSIGNALIZED

LEVEL OF SERVICE	AVERAGE TOTAL DELAY (SEC/VEH)
A	≤ 10
B	> 10 and ≤ 15
C	> 15 and ≤ 25
D	> 25 and ≤ 35
E	> 35 and ≤ 50
F	> 50

[1] ***Highway Capacity Manual, Special Report 209***, Chapters 1 and 9. National Research Council, Transportation Research Board, Washington, DC. 2000.

Synchro, Version 5.0, software was used for determining the capacity, average delay, and corresponding level of service at each intersection. The results of scenario analyses for each intersection are presented in tables throughout this document. Synchro summary reports from the analyses are provided in the Appendix.

Peak-hour turning moving counts were conducted the week of November 13, 2001 by the City of Greenville for use in this study. In addition, ADT's were collected along Church Street. The count data can be found in the Appendix.

Current AM and PM peak hour conditions were analyzed for the signalized intersections along Church Street from Augusta Street to University Ridge. Table 1 below depicts the operational characteristics of the intersections under existing conditions.

TABLE 1: LEVEL OF SERVICE - EXISTING CONDITIONS

Intersection	AM Peak Hour			PM Peak Hour		
	Delay (sec/veh)	Capacity (v/c)	Level of Service	Delay (sec/veh)	Capacity (v/c)	Level of Service
2001 Existing Conditions						
Church Street and Augusta/Mills Street (signalized)	39.1	0.95	D	50.9	*	D
Church Street and University Ridge (signalized)	15.9	0.55	B	35.4	0.99	D

* Delay calculations are not meaningful when v/c exceeds 1.2 or when delay value exceeds 180 seconds.
For unsignalized intersections, delay, v/c (Flow Rate/Movement Capacity), and LOS corresponds to most critical movement

The analysis of existing conditions indicates that the Church Street corridor currently operates within acceptable levels of service during both the morning and afternoon peak hours in 2001.

ADDITIONAL ANALYSIS

In an effort to understand the potential impact of the streetscape modifications to Church Street, analyses of the study intersections were conducted for the proposed streetscape modifications. The projected background traffic volumes used in this and subsequent analyses were derived by applying a 3% annual growth rate to the 2001 peak hour values.

Considering existing traffic volumes, the Church Street corridor could be characterized "under" capacity due to excess laneage. While the six-lane section does provide the ability to move large volumes of traffic, this six-lane capacity is only present between the signalized intersections of University Ridge and Augusta/Mills Avenue. Presently, the signalized intersections within the study area provide only two through lanes, except for the southbound approach of

University Ridge. Given the reduced capacity north and south of the study area, the operational benefits associated with the 6-lane capacity is not fully realized.

While the surplus capacity exhibits insignificant gains in traffic operations, its mere presence has other negative impacts on the surrounding community. Specifically, the current laneage configuration creates a pedestrian barrier due to the added expanse that a pedestrian must traverse. A reduced typical section that includes two through lanes in each direction supported by an auxiliary left turn lanes at cross street intersections is expected to adequately accommodate predicted future year volumes which simultaneously increase the aesthetic and walkability characteristics of the corridor. For this reason, a recommended typical section was also evaluated. This section would include two through lanes with a landscaped median and left turn lanes at the cross street intersections. This modified typical section was modeled using predicted 2011 traffic volumes to determine the capacity and LOS for the critical intersections for this segment of Church Street. It is important to note that the through lane links between intersections is reduced from 6-lanes to four; however, the existing laneage at the signalized intersections is retained in order to maintain adequate traffic operations. The only minor change accounted for is the conversion of the outside, southbound thru-right at University Ridge to a dedicated right-turn lane. Table 2, below, depicts the results of this analysis.

TABLE 2: LEVEL OF SERVICE – 2011 HORIZON YEAR

Intersection	AM Peak Hour			PM Peak Hour		
	Delay (sec/veh)	Capacity (v/c)	Level of Service	Delay (sec/veh)	Capacity (v/c)	Level of Service
2011 Existing Laneage – No Improvements						
Church St. and Augusta/Mills Ave. (signalized)	49.7	0.99	D	69.7	1.13	E
Church St. and University Ridge (signalized)	28.2	0.66	C	53.5	1.09	D
2011 Revised Laneage – With Improvements						
Church St. and Augusta/Mills Ave. (signalized)	49.5	0.99	D	54.0	1.18	D
Church St. and University Ridge (signalized)	28.8	0.77	C	52.0	1.09	D

* Delay calculations are not meaningful when v/c exceeds 1.2 or when delay value exceeds 180 seconds.
For unsignalized intersections, delay, v/c (Flow Rate/Movement Capacity), and LOS corresponds to most critical movement

Given the average performance of the study intersections under existing conditions, it was not surprising to find that all of the intersections operate at an acceptable level of service in 2011. While overall intersection Level of Service is LOS "D", some movements experience greater delay then others. However, this

increased delay is not a result of reducing capacity on Church Street, rather it is a result of increased traffic volumes at the intersections. While there is a decrease in capacity and an increase in delay at the intersections, this is to be expected considering the overall growth in traffic over 10 years. To achieve an acceptable level of service for the intersection of Church St and Augusta / Mills Avenue, a southbound right-turn lane was added. This movement experiences a significant volume that may necessitate the laneage addition in the future years. In addition to the right turn lane, the Church Street corridor was analyzed as a coordinated signal system. This will allow for better progression between signals thereby improving intersection capacity and reducing delay as compared to an uncoordinated system. Given the overall acceptable intersection level of service, this analysis demonstrates that the proposed modifications to Church Street will not have a profound effect on capacity or the ability to process traffic at the intersections.

Because the laneage remains constant at both of the intersections, an analysis of the connecting links was performed. This additional analysis calculates the operations (LOS) of the roadway link segments in addition to the intersections performance. Using the Highway Capacity Manual, Chapter 21, it was determined that the multilane arterial would operate at LOS “A” in both the northbound and southbound directions during the AM peak hour and LOS “B” during the PM peak hour for the north and southbound directions in 2001. In 2011, the northbound lane operates at LOS “B” during the am peak hour and LOS “C” during the PM peak hour under the modified laneage scenario. The southbound lanes will operate at LOS “C” during the AM Peak hour and LOS “D” during the PM peak hour under the modified laneage scenario. Given this information and the Level of Service analysis at the intersections, it can be demonstrated that the modifications may not severely impact the overall operations of the corridor.

While the aforementioned analysis represents a typical weekday, it is likely that holiday, weekend, and summer month traffic volumes may increase slightly above the recorded volumes. Furthermore, the traditional peak hours for the commuter traffic tends to be different from that of the visitor and tourist. The typical travel times for visitors and tourist is expected to be during the non-critical off-peak hours. Therefore, it is expected that the roadway would be able to accommodate the possible increase in traffic volumes.

HAYNIE / PEARL INTERSECTION

As the neighborhood master plan is implemented, the focus on the Haynie Street / Pearl Avenue corridor as a critical east-west connector will become evident. These streets in association with the building type and scale proposed in the master plan combine to enhance both the pedestrian and vehicular linkage between Augusta Street and Cleveland Street. Furthermore, the intensity of development associated with the buildout of the neighborhood master plan relies heavily on the mobility afforded by this east/west connection. As redevelopment occurs, the distribution and traffic volumes on these roadways are expected to significantly increase. Therefore, it is likely that the Haynie/Pearl intersection with Church Street will meet required signal warrants in the future. Fortunately, the geographic location of this intersection lends itself to strong coordination between the signalized intersections to the north and south given its' optimum 1,000+ foot spacing from either intersection. Any future modification to the Church Street corridor should plan to accommodate the future signalization of this intersection and efforts should be made to coordinate signal timings and progression for increased peak hour corridor operations.

RECOMMENDATIONS

There are clearly many considerations in the design of roadway modifications, including cost, capacity, land uses, and the use of appropriate design criteria. It is essential that in the design of a facility, the primary focus should remain to provide safe and efficient transportation for all modes. The application of the design standards and the design compromises that occur must always stay within the confines of maintaining safety and enhancing the operational efficiency of the roadway.

The following steps are recommended:

- Conduct a comprehensive corridor operations study for the entire Church Street corridor (include the trips associated with the buildout of the proposed Haynie–Sirrine Neighborhood Master Plan and potential signalization of the Haynie-Pear intersection). Other consideration may include Travel Demand Management techniques for the downtown vicinity.
- A functional design / feasibility study should be prepared based on the corridor operations study and the Neighborhood Master Plan.
- Study the feasibility of coordinating signals throughout the entire corridor.
- Investigate the expansion of existing transit service to include future stops along the Church Street corridor.

CONCLUSIONS

While the information contained herein implies the feasibility of reducing the Church Street corridor from 6-lanes to a 4-lane divided section, we also understand the importance of Church Street as a radial arterial whose function must accommodate the ingress and egress of peak hour commuter traffic. However, it is clear that that current configuration between Augusta and University Ridge provides little benefit to this cause and the cost of maintaining this excess capacity includes both a financial and social burden. Like many urban renewal projects, the priority of vehicular mobility overshadowed the impact to surrounding (typically minority) neighborhoods. The proposed modification of Church Street would be a proactive reparation consistent with federal Environmental Justice policies. Most importantly, the proposed Church Street changes are necessary to promoted and retain the implementation of the Neighborhood Master Plan which will have other transportation benefits: a mix of land uses, walkable urban environment, and increased residential density within close proximity to downtown Greenville. These factors when combined support other transportation initiatives through reduced vehicular trips, and the enhancement of alternate modes including pedestrians, bicycles, and transit opportunities.

Given the vast amount of right-of-way and excess capacity, all proposed modifications to the Church Street corridor should be able to be accomplished within the existing transportation corridor. In fact, the typical section developed during the design charrette could be implemented within the existing curb. The possibility of retaining the curb has a significant cost savings to the possible implementation of the plan. Finally, the reduction in through lanes, lane widths, and the addition, of street trees, lighting, and buildings located close to the street, will effectively tame the roadway increasing the comfort of all modes within the corridor without severely effecting operations.

As the Greenville Department of Transportation and South Carolina Department of Transportation continues to investigate ways to reduce congestion and delays along the Church Street corridor, communication with developers and property owners will play a critical role in implementation of the master plan. Until such time that finalized corridor plans are approved, local governments must communicate potential and desired improvements possible for the corridor. Site specific analysis of limited segments of the corridor (such as the analysis contained herein) can only demonstrate limited options without regard to their overall feasibility given the limited scope and area of influence. Expanded corridor analysis will provide information regarding possible long-term solutions for the preservation and enhancement of overall corridor performance.